



Standard Specification for Corrugated Asbestos-Cement Sheets for Bulkheading¹

This standard is issued under the fixed designation C 746; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers the types, physical properties, and dimensions of bulkhead corrugated asbestos-cement sheets designed to provide sheet piling for erosion control along fresh-water lake shores and inland waterways of fresh or salt water.

1.2 The following precautionary caveat pertains only to the test method portion, Sections 9-12 of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

C 208 Specification for Cellulosic Fiber Insulating Board²

C 460 Terminology for Asbestos-Cement³

2.2 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁴

2.3 Military Standard:

MIL-STD-129 Marking for Shipment and Storage⁴

2.4 BNQ Standard:

BNQ Standard 3807-098 Vulcanized Rubber-Hardness Determination⁵

3. Terminology

3.1 Definitions:

3.1.1 *flexural strength, n*—the transverse breaking load in newtons per meter of width (lbf/ft of width) of saturated sheets

when loaded on a span of 1.524 m (5 ft) with the load applied equally and simultaneously at both one-third points of the span.

3.1.2 Refer to Terminology C 460 for additional terminology.

4. Classification

4.1 The corrugated asbestos-cement sheets covered by this specification are classified on the basis of the bending moment capacity of saturated units.

Designation (Note 1)	Bending Moment Capacity (Minimum)
Type 1	1270 N-m/m of width (285 lbf-ft/ft of width)
Type 2	2250 N-m/m of width (505 lbf-ft/ft of width)
Type 3	3600 N-m/m of width (790 lbf-ft/ft of width)
Type 10	4450 N-m/m of width (1000 lbf-ft/ft of width)
Type 18	5800 N-m/m of width (1300 lbf-ft/ft of width)

NOTE 1—The bending moment capacity required for a given installation depends upon many variables. Its determination is illustrated in the design manuals of the producing companies. The color coding for the various types of bulkhead corrugated is painted on one end of the sheet to designate type: Type 1-brown, Type 2-green, Type 3-red, Type 10-gray, Type 18-yellow.⁶

5. Materials and Manufacture

5.1 Corrugated asbestos-cement sheets for bulkheading shall be composed of a combination of asbestos fiber and portland cement, or portland blast furnace slag cement, and not more than 1 weight % of organic fiber, with or without the addition of curing agents, silica, water-repellent substances, mineral fillers, coatings, pigments, or mineral granules, formed under pressure and cured to meet the physical requirements of this specification.

6. Physical Properties

6.1 *Strength*—The corrugated bulkhead product shall conform to the bending moment requirements of 4.1 when tested in accordance with the methods prescribed in Section 12 of this standard.

6.2 Tolerances on the Nominal Dimensions:

6.2.1 Length tolerance shall be ± 6.4 mm ($\frac{1}{4}$ in.).

¹ This specification is under the jurisdiction of ASTM Committee C17 on Fiber-Cement Products and is the direct responsibility of Subcommittee C17.03 on Asbestos-Cement Products.

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² *Annual Book of ASTM Standards*, Vol 04.06.

³ Discontinued and replaced by D 2946. See 2000 *Annual Book of ASTM Standards*, Vol 04.05.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094. Attn: NPODS.

⁵ Available from Bureau de Normalisation du Québec. Department of Industry and Commerce, 50 Saint Joseph Street East, Québec QC Canada G1K 3A5.

⁶ Design Manual for Asbestos-Cement Canal Bulkheads published by the Mineral Fiber Products Bureau. Available from the Asbestos Institute, 1130 Sherbrooke Street W, Suite 410, Montreal, QC Canada H3A 2M8.

6.2.2 Width tolerance shall be ± 6.4 mm ($\frac{1}{4}$ in.).

6.2.3 Thickness tolerance shall be $\pm 7.5\%$.

6.3 *Pitch*—The nominal pitch as designated by the manufacturer is the distance between midpoints of adjacent crests of the corrugated. The tolerance for pitches on a single sheet or between sheets shall be $\pm 7.5\%$.

6.4 *Corrugation Depth*—The nominal depth of the corrugated is the overall maximum thickness measured from the base of the vale to the top of the crest. The tolerance for depth between sheets shall be $\pm 7.5\%$. For information on the dimensions or shapes, of products available to meet this specification, consult the manufacturer’s literature.

7. Dimensional Measurements

7.1 *Thickness*—Measure the thickness of each specimen to the nearest 0.025 mm (0.001 in.) at the crest and vale by a micrometer having ball anvil and ball spindle ends approximately $\frac{1}{8}$ to $\frac{1}{4}$ in. (3 to 6 mm) in diameter, or an anvil and spindle, each with a 30° taper and a 0.4 mm ($\frac{1}{64}$ -in.) flat at its end. Place the anvil or spindle of the micrometer between the projections on the back of the sheet so as to measure the flat plane surface. The thickness shall be the average of at least four measurements, two of which are on the crest (one at each end) and two of which are in the vale (one at each end).

8. Workmanship, Finish, and Appearance

8.1 *Workmanship*—The corrugated bulkheading surface shall be relatively smooth and free of defects that impair appearance or serviceability.

8.2 *Color*—Color shall be the natural color of the asbestos-cement product, or as agreed upon between the purchaser and the seller. Efflorescence that sometimes may appear is not considered to be a defect on natural color asbestos-cement sheets.

TEST METHODS

9. Sampling

9.1 From each shipment or fraction thereof representing a product of the same type, a number of sheets shall be selected at random. Table 1 shows the number of sheets to be selected from shipments of various sizes.

10. Rejection and Retest

10.1 If the sample fails to conform to the requirements of this specification, a second sample from the same lot shall be prepared and tested. The results of the retest shall be averaged

with the results of the original test to determine compliance with this specification.

10.2 Failure to conform to the requirements of this specification upon retest as prescribed in 10.1 shall constitute grounds for rejection. The seller shall have the right to reinspect the rejected shipment and resubmit the lot after removal of the portion of the shipment not conforming to the specified requirements, provided this is done within 20 days after the receipt of notice of the specific cause of rejection.

11. Specimen Preparation

11.1 Immerse all specimens to be tested for strength characteristics in a tank containing clean water at 15.6 to 26.7°C (60 to 80°F) covering the uppermost crests by at least 25 mm (1 in.) of water. Remove after 24 h and conduct the tests within $\frac{1}{2}$ h after removal.

11.2 Prior to testing, any specimen showing obvious visual defects shall not be included for testing, and shall be replaced with another specimen.

12. Flexural Strength Test

12.1 *Significance*—The flexural strength is used to ascertain ultimate bending moment capacity for comparison with design specifications. If side lap occurs in the specific design, this increases the factor of safety.

12.2 *Size of Specimens*—Specimens shall be 1680 ± 13 mm ($66 \pm \frac{1}{2}$ in.) in length. Full width sheets are used for the flexural strength test. For sinusoidal corrugated shapes, three complete corrugations are adequate for the width. The length shall be parallel to the corrugations. Cracked or otherwise damaged specimens shall not be tested, but substitute specimens shall be provided.

12.3 *Apparatus*—The apparatus shall be assembled as shown in Fig. 1 and Fig. 2 and shall conform to the detailed requirements for component parts prescribed in 9.4.1 through 9.4.5, or the equivalent.

TABLE 1 Sheet Selection

Number of Sheets in Shipment	Number of Sheets to Be Selected at Random
500 and under	3
501 to 1000	5
1001 to 1728	6
1729 to 2744	7
2745 to 4096	8
4097 to 5832	9
5833 to 8000	10

Additional sheets may be tested at the discretion of the inspector.

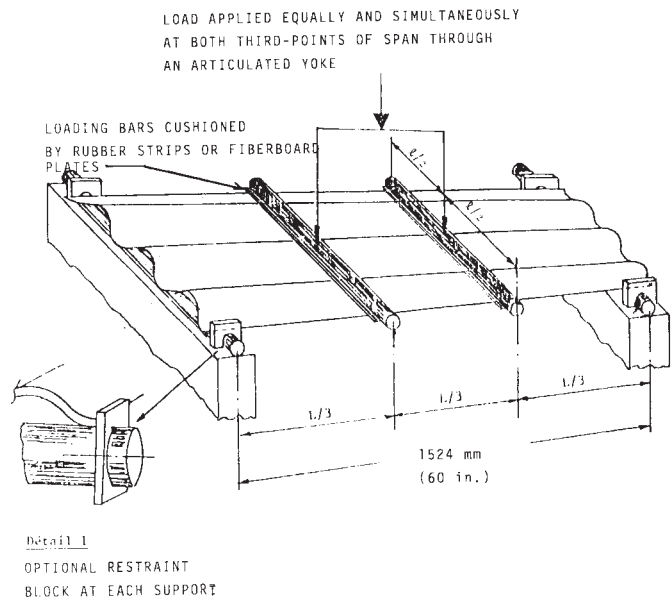


FIG. 1 Flexural Strength Test—Bar Fixture

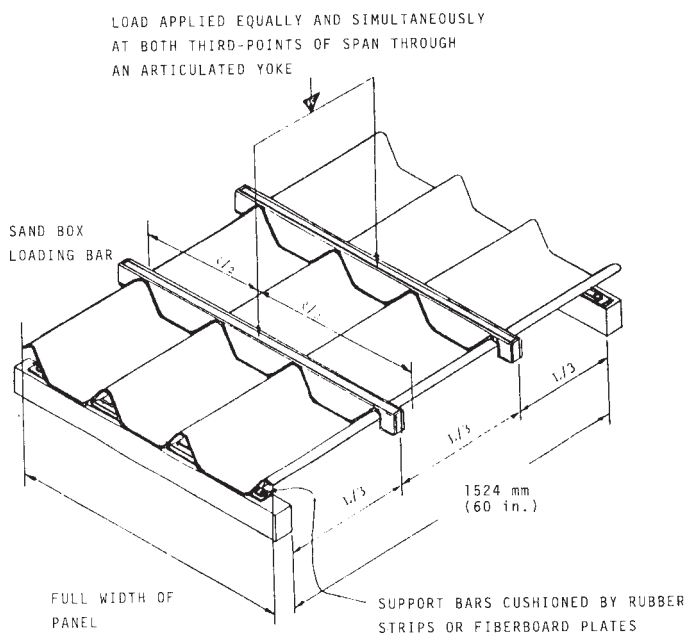


FIG. 2 Flexural Strength Test—Sand-Box Fixture

12.3.1 *Supports*—Two steel rollers 50 mm (2 in.) in diameter of a length equal to or greater than the specimen width, with a plate as specified in 9.4.2 between each supporting roller and the specimen. Supports shall not exert longitudinal constraint.

12.3.2 *Bearing Cushions*—Use rubber strips 19 mm (3/4 in.) thick by 40 mm (2 in.) wide with a hardness of 65 ± 5 DDC (as determined by BNQ Method 3807-098) to cushion the supports and loading bars (with the exception of sand box type loading bars). Alternatively use wood fiberboard 13 mm (1/2 in.) thick and 50 mm (2 in.) in width, meeting the requirement of Class A in Specification C 208.

12.3.3 *Edge Restraint Blocks*—Steel or other suitable material may be provided to remain in contact with each edge of the specimen at each support to prevent outward movement of the specimen. The blocks shall be of sufficient height to restrain the specimen edges, 25 mm (1 in.) thick, 50 mm (2 in.) in length, and parallel to the span. The blocks shall be firmly attached to the supports.

12.3.4 *Loading Assembly*—There are two types of loading assemblies which may be used in performing this test, a bar assembly and a sand-box assembly. The bar assembly is generally used for corrugated bulkhead with a pitch less than 130 mm (5 in.). The sand-box assembly is recommended for all other shapes.

12.3.4.1 *Bar Assembly*—Two 50-mm (2 in.) diameter steel rollers linked by a yoke to permit equal and simultaneous loading at both one-third points of the span of a length equal to or greater than the specimen width, with a wood fiberboard plate as specified in 9.4.2 between the loading roller and the specimen. See Fig. 1.

12.3.4.2 *Sand-Box Assembly*—Sand confined in an enclosure conforming to the profile of the specimen. The sides shall be constructed of 40 mm (1.5 in.) lumber with an outside width of 130 mm (5 in.). The bottom of the box shall be closed by nailing a 3-mm (1/4-in.) flexible rubber sheet to the profiled

edge. The length of the fixture shall be equal to the specimen width and the height shall be such as to allow a minimum of 40 mm (1.5 in.) over the crests of the specimen. The enclosure shall be placed on the midspan of the specimen, filled with dry sand, carefully leveled and compacted, and a 50 by 50-mm (2 by 2-in.) section of wood placed on top of the sand. The load shall be applied through the 50 by 50-mm (2 by 2-in.) wood uniformly over the specimen width. See Fig. 2.

12.4 *Procedure:*

12.4.1 Place the specimen, exposed face down (exposed face is the smoother surface), on supports.

12.4.2 *Loading*—Use third-point loading for transverse load tests. Test the specimen as a simple beam (Fig. 1 and Fig. 2) on a 1524 ± 6 -mm ($60 \pm 1/4$ in.) span.

12.4.3 *Loading Device Accuracy*—The loading machine may consist of any mechanically-driven or hand-powered device that meets the following requirements:

12.4.3.1 It shall be substantially built and rigid enough throughout so that distribution of load to the specimen will not be affected appreciably by deformation or yielding of any part,

12.4.3.2 It shall provide for continuous application of load at a uniform rate to have failure occur in one to two min, and

12.4.3.3 It shall provide means for determination of load with an error not greater than 2%.

12.4.4 *Load*—Record the breakload for each specimen, and include the weight of the sand-box assembly, if used.

12.4.5 *Break Point*—The failure point or break in the specimen shall occur within the central third of the specimen between the loading bars. Any break occurring beyond these limits indicates a defective specimen, and the equation in 12.4.6 is not applicable. Such a specimen shall not be included in the results.

12.4.6 *Moment Capacity*—Calculate the resisting or bending moment capacity of the specimen from the total transverse breaking load per metre (foot) of width as follows:

$$M = PL/6 \tag{1}$$

where:

- M = bending moment in N·m/m of width (or lbf·ft/ft)
- P = breakload (including weight of sand-box if used), N/m (or lbf/ft) of width at failure
- L = span, m (or ft)

13. **Inspection and Certification**

13.1 Inspection and certification of the material shall be as agreed upon by the purchaser and seller as part of the purchase contract.

14. **Packaging and Shipping**

14.1 *Commercial Quantities*—Corrugated asbestos-cement sheets for bulkheading are marketed per sheet, depending upon length.

14.2 *Commercial Packaging*—Sheets shall be so shipped as to ensure acceptance by common carrier. There is no standard package. This material is usually shipped in bulk, but may be crated when so specified by the purchaser.

14.3 *Storage*—Sheets shall be piled on supports that are sufficiently firm to keep the sheets level and spaced at intervals to prevent bending.

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply when material is supplied under this specification for U.S. Government procurement.

S1. Packaging

S1.1 Unless otherwise specified in the contract, the material shall be packaged in accordance with the producer's standard practice which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification Rules⁷ or National Motor Freight Classification Rules.⁸ Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

⁷ Available from The Uniform Classification Commission, Room 1106, 222 S. Riverside Plaza, Chicago, IL 60606.

⁸ Available from National Motor Freight Inc., 1616 P. St., N.W., Washington, DC 20036.

S2. Responsibility for Inspection

S2.1 Unless otherwise specified in the contract or purchase order, the producer is responsible for the testing of all material to ensure compliance with the requirements specified herein. Except as otherwise specified in the contract or order, the producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

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